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MACHINERY COST OF FARM OPERATIONS IN WESTERN NEW YORK.

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Farm machinery is utilized to the best advantage when it is used in profitable work continuously until it is worn out.[1] If a mower will give 50 days of actual service, it would be more economical to wear it out in 50 days of continuous service than by working it 5 days a year for 10 years. If such a mower costs $45, and money is worth 6 per cent, the total cost of using the mower 50 days, not counting repairs, is $45 plus 37½ cents interest. But if the mower is used for 50 days spread out over 10 years, the total cost rises to $45 plus $14.85 interest,[2] and the interest charge per acre or per ton of hay becomes 40 times as great as in the first instance. There is also a replacement cost; that is, the sum which must be charged against the machine annually to provide for getting a new machine when it wears out, which tends to make it more economical to make the most of a machine while it is comparatively new. If machinery could be kept from deteriorating from rust and decay, this replacement cost per

[1] In addition to cost of operation, the use of farm machinery entails three kinds of expense, as follows: (1) To provide for the replacement of the implement when it is worn out; (2) to pay interest on the cost of the machine; and (3) to keep it in repair. These are referred to in the following text and tables as replacement cost, interest charge, and repairs, respectively. In most cases there is also more or less expense for shelter for the machinery.

[2] If the mower lasts 10 years, 10 per cent being charged off annually for replacement, the average amount upon which 6 per cent interest is earned is $24.75, the interest on $24.75 for 10 years at 6 per cent being $14.85.

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acre or per bushel or ton would be constant, but in actual practice a machine used but a few days per year lasts only a little longer than a similar machine used twice as much. Thus the replacement cost per acre depends largely on the number of days per year the machine is used.

From the standpoint of good management, therefore, the farmer should try to organize his business so as to obtain the maximum of profitable use annually from his machinery equipment, thereby reducing the machinery cost per day of work to the minimum.

The study upon which this bulletin is based was made with a view to gathering facts and figures which might be of value to the farmer in his efforts to cut machinery cost. To this end figures were obtained to determine the average number of years of service given by each of the various implements in use in the part of New York where the investigation was made, and from the average life of each implement and its cost when new the approximate cost of its operation has been calculated.

SUMMARY OF RESULTS.

Briefly summarized, these are the more important facts brought out or substantiated by this investigation:

The more days' work done annually by an implement the greater is its total of days and acres of work done before wearing out.

The average farm machine used in this section is less than half worn out by use alone.

The more days of actual use obtained annually from an implement the less the interest charge per acre and per day actually used.

The replacement cost per acre or per bushel or ton is from two to seven or eight times as great for small acreages as for large acreages.

The farmer with a small acreage can not compete in economy in the use of machinery with the farmer having a larger business. With the best of shelter and care, the small farm can only hope to equal the replacement cost per unit enjoyed by the large farm; it can not hope to avoid higher interest charges.

As a rule, it is not profitable to build for machinery any special shelter which adds over 15 per cent to the total machinery investment on a farm.

Repair charges per machine increase with increasing use, but not in proportion to the amount of work done. In other words, repair charges per acre and per day decrease as the acreage covered annually increases.

The larger and more substantial sizes of machinery give cheaper service than the lighter sizes, since the cost for repairs is much lower for the heavy machine than for the lighter machine, while the first cost is but a fraction greater.

In Table I is summarized the average service and cost of the principal implements used in western New York. The annual service obtained is expressed in acres and in days. The total service rendered is expressed in years, days, and acres. The average cost of each implement is shown, and the machinery cost per acre, comprising depreciation, interest, and repairs, is set out for each implement.

In referring to the cost per acre covered, as shown in this table, it should be borne in mind that these figures are averages and that they do not show the very important bearing which variation in the acreage covered annually has upon the cost per acre of using a machine. This relation is brought out strikingly in the tables that follow. For example, it will be shown that where a mower covers but 13.8 acres annually it costs the owner 36 cents per acre, while the mower that covers 53.6 acres annually costs but 10 cents per acre cut.

TABLE I.—*Summary, showing average service rendered by 18 kinds of farm implements in western New York, and average machinery cost per acre.*

Implement.	Average days' work per year.	Life of implement.		Acres covered.		Cost per acre covered.				Cost, new.
		Days of work.	Years.	Per year.	Total.	Replacement.	Interest.	Repairs.	Total.	
Walking plow	19.2	224	11.7	32.9	384.9	$0.026	$0.010	$0.062	$0.098	$10.00
Sulky plow	14.7	119	8.1	30.9	250.3	.170	.046	.069	.285	42.50
Spring-tooth harrow	6.6	73	11.0	71.1	782.1	.023	.007	.011	.041	17.50
Spike-tooth harrow	3.1	43	14.0	48.3	676.2	.016	.007	.007	.030	10.50
Disk harrow	4.2	54	13.0	35.2	457.6	.059	.025	.014	.098	27.00
Land roller	4.7	75	16.0	65.9	1,054.4	.023	.011	.007	.041	24.00
Grain drill	4.6	76	16.4	46.3	759.3	.095	.049	.027	.171	72.00
Corn planter, 1-row	.9	10	11.7	4.1	48.0	.250	.111	.170	.531	12.00
Corn planter, 2-row	.8	9	11.0	8.2	91.3	.440	.158	.200	.798	40.00
Cultivator, 1-row	4.1	58	14.0	16.9	236.6	.027	.012	.021	.060	6.50
Cultivator, 2-row	5.6	70	12.5	39.3	491.3	.065	.027	.025	.117	32.00
Cabbage transplanter	3.4	43	12.8	12.5	160.0	.280	.114	.091	.485	45.00
Mower	3.1	46	14.8	28.0	414.4	.099	.047	.065	.211	41.00
Hay rake	2.6	37	14.5	43.0	623.5	.038	.019	.008	.065	24.00
Hay tedder	1.5	21	14.0	21.6	302.4	.112	.051	.019	.182	34.00
Bean harvester	2.3	29	12.9	16.9	218.0	.115	.048	.060	.223	25.00
Grain binder	3.4	53	15.4	35.2	542.1	.231	.113	.058	.402	125.00
Corn binder	3.7	40	10.8	21.1	227.9	.550	.194	.096	.840	125.00

SCOPE OF INQUIRY.

Under actual conditions on the farm there are other factors than use which affect the service obtained from farm machinery. These are (1) exposure to the weather, (2) care in operation, and (3) design and material used in the construction of the implements. No attempt was made in this inquiry to determine the relative influence of exposure, care, and design on the total service rendered by farm implements The sole purpose was to determine how much service standard farm machinery gives in western New York under the average of the conditions existing there. No mechanical or engineering features were considered.

The larger the acreage the farmer has over which he profitably can work a machine, the more able is he to afford a well-built article of good design. There is no doubt, also, that farmers having large capital and business will average better as operators of machinery than will men who are content or obliged by personal limitations to operate a small business. Data obtained in this section regarding repairs also indicate that farmers having the larger acreages to work do so with the lower repair charges per acre. This is due, partly at least, to the fact that some repairs are made necessary because of deterioration when the machinery is idle. But it is probably also due in part to the fact that the better managers on the large farms make repairs, adjustments, and give other needed attention promptly, thereby reducing the repair costs and obtaining more units of work from each implement. The economic aspects of expenditure to shelter farm machinery from exposure to the elements are referred to hereafter.

SOURCES OF DATA.

An inquiry addressed to several thousand farmers in Niagara, Orleans, Monroe, Wayne, Genesee, Livingston, and Ontario Counties in western New York afforded a considerable mass of data from which the utility of farm machinery in this section has been determined. Facilities for housing machinery in this section are very much better than the average the country over, the natural thrift of the farmers leading them to house such property as much as possible. On account of the large amount of rainfall, hay and grain crops are usually stored in the relatively large barns typical of the area, so that during the summer months many farm implements stand out exposed to the weather until the barns are emptied of these bulky crops. At other seasons, however, the machinery is well housed. In mechanical ability there is no doubt that the farmers in this section are the equal of any.

In response to the inquiry reports were obtained for 1,165 walking plows, 294 sulky plows, 1,169 spring-tooth harrows, 824 spike-tooth harrows, 738 disk harrows, 1,173 land rollers, 1,061 grain drills, 72 one-row corn planters, 97 two-row corn planters, 1,114 one-horse cultivators, 881 riding cultivators, 217 cabbage transplanters, 359 engine sprayers, 1,232 mowers, 1,217 hay rakes, 416 hay tedders, 563 bean harvesters, 1,028 grain binders, and 458 corn binders. The bean harvesters, cabbage setters, and corn binders are used chiefly in Livingston and Genesee Counties, while the engine sprayers have their widest use in the fruit-growing counties along the lake. The other implements are used on nearly every farm. Corn is planted almost entirely with the grain drill, few corn planters being used.

METHOD OF COMPUTING MACHINERY REPLACEMENT COSTS.

There are a number of ways in which replacement costs may be computed and distributed, but a discussion of these methods and their application to the various types of business and conditions where they are in vogue would be out of place here.

The method chosen as being best adapted for use on the farm consists in charging off annually a part of the first cost of the implement in proportion to its use on the farm and under field conditions. Thus by reference to Table II for walking plows, the service rendered by a plow that covers 15.6 acres annually is 12.5 years, so that the part that should be set aside annually to provide for the replacement of this plow (1÷12.5) is 8 per cent of the first cost of the plow. In other words, the replacement charge per year, per acre, or per day is based on proportional use and not on the market valuation or sale price of the equipment at any time during its life. From the standpoint of the man on the farm who expects to remain in the business, this is a logical method to use. To the great majority of farmers, who intend to continue in the farming business for periods exceeding the duration of the life of their machinery, the tables which follow will be found useful in estimating the machinery cost of proposed work and the fair charge against work already done. To the man expecting to discontinue farming and sell his machinery, or to the man negotiating for the purchase of second-hand implements, knowledge of the further units of work that may be expected from machinery that has already performed a given amount will assist in determining its fair value to both buyer and seller.

METHOD OF COMPUTING THE INTEREST CHARGE.[1]

Where a part of the first cost of equipment is charged off annually to provide for its replacement, the average investment upon which interest must be allowed is shown in the schedule below:

Fraction of cost new charged off annually.	Average investment (per cent of first cost).	Fraction of cost new charged off annually.	Average investment (per cent of first cost).	Fraction of cost new charged off annually.	Average investment (per cent of first cost).
All	100.00	One-eighth	56.25	One-fifteenth	53.33
One-half	75.00	One-ninth	55.55	One-sixteenth	53.12
One-third	66.66	One-tenth	55.00	One-seventeenth	52.93
One-fourth	62.50	One-eleventh	54.54	One-eighteenth	52.77
One-fifth	60.00	One-twelfth	54.17	One-nineteenth	52.63
One-sixth	58.33	One-thirteenth	53.84	One-twentieth	52.50
One-seventh	57.14	One-fourteenth	53.57		

[1] The average investment in equipment, where a fraction of its first cost is charged off each year for replacement, may be found by the rule: Average investment=first cost$\times\frac{\text{years of service}+1}{\text{years of service}\times 2}$.

By multiplying the average investment by the prevailing rate of interest in the locality where the equipment is located the average annual interest charge against the equipment is found. In connection with the tables which follow the replacement cost and the interest charge have been computed by the foregoing methods in terms of the year, the acre, and the day actually used.

METHOD OF DETERMINING THE SERVICE OF FARM MACHINERY.

The farm conditions which affect the annual service rendered by machinery are so many and various in the same locality, and so different between widely separated areas, that no general method of approximating the annual depreciation is feasible. Actual records on a sufficiently large number of machines extending through a period of years long enough to determine the life in use can not be secured on account of the expense and improbable continuity of the record keeping. A method was found, however, which yielded results rapidly and gave averages based on large numbers of reports for each kind of implement,[1] this method being used in obtaining data in the limited area in western New York, which is presented in the tables that follow:

EXPLANATION OF THE TABLES.

In the tables the machines are, in most cases, grouped according to the amount of work done annually. In all cases the years of service decrease with increasing annual use, but not in the same proportion. This is due to the fact that machinery depreciates to some extent when not in use. The decrease in length of time with increased annual use would be greater than actually shown in the tables were it not for the fact that the machines used on the smaller acreages are smaller and less substantially built. The average size of the implements doing the respective amounts of annual work is shown in the third line in each table.

The service of each implement is expressed in years and acres and in days of actual use. The performance in years was found by the method already explained; the service in acres was obtained by multiplying the service in years by the average work done annually;

[1] Where the number of machines in a given area is stationary, the design and construction uniform and established, and the implement has been in use there for a period exceeding the average life of such implement, the average years of service may be found by dividing the entire number by the number one year old.

Or, under the conditions just mentioned, the average service may also be found approximately by adding the present age of the respective machines reported, dividing by the total number to obtain the average present age of the group, multiplying this average by 2 and subtracting 1. By the latter method not such large numbers are required to insure a reliable average.

In computing the service in years for the tables in this bulletin both methods were used, and, while the results were practically the same in most cases by each method, they were combined and the average taken to offset to some extent the too great influence of the occasional very old individual on the average obtained by the second method.

the work in days was found by dividing the service in acres by the normal acreage or day's work done by the implements of the respective average sizes. This normal day's work, or daily duty of the respective machines, was also obtained from the same farmers in western New York.

Following each table, the replacement cost and interest charge to correspond have been computed, using 6 per cent as the local interest rate. The interest charge for any other rate may readily be found by applying proportion to the averages here given.

THE COST OF REPAIRS.

Where ordinary care is used by the operator, the repair charges for most kinds of farm machinery used in growing crops should make up but a small proportion of the total cost of production. It is often desirable, however, to know what the average repair charge for the different machines may be in order to arrive at a fair allowance for such repairs in planning future farm work or in determining the cost of work already done. But little data have ever been made available that could be used by the man on the farm, the county agent, the agricultural instructor, or the investigator in farm organization and management, in determining the repair cost for the machinery used on any given farm enterprise.

In the same inquiry through which the data on the service of the farm machinery was obtained for western New York, the repair charges against these implements were also accumulated. In all of the tables the total amount of repairs during life is given for each implement, corresponding to the same annual service for which the replacement and interest charges have been computed. The cost of repairs per year, per day actually used, and per acre can be readily computed. Tables II to XIX afford complete data, therefore, for this area, on the machinery cost of farm operations.

DETAILED STUDY OF IMPLEMENTS.

WALKING PLOW.

From Table II, for walking plows, it appears that the average plow used in this section is about 12 inches wide; that it averages 32.9 acres of plowing annually, and lasts on the average 11.7 years. During this time it covers an average of 384.9 acres and is used a total of 224 days. Of all farm implements, the walking plow gives by far the most days of service. The heavier plows do more work annually. They also plow more acres and do more days of work before they are worn out. Since the walking plow is an implement of low cost, the interest charge is relatively low. Its long use reduces the replacement charge per acre, but the heavy work required of it makes the repair charge per acre equal that of a grain binder and exceed that for most of the other implements.

TABLE II.—*Walking plows—relation of work done annually to service and cost per acre and per day used on 1,165 farms.*

Range of area covered annually.....acres..	1 to 20.	21 to 30.	31 to 40.	41 to 50.	51 and over.	Average.
Number of records included	263	407	292	120	83	.....
Average area covered annually.....acres..	15.6	28.0	39.6	48.4	68.5	32.9
Years of service rendered	12.5	12.2	11.7	11.0	8.6	11.7
Acres covered during life	195.0	341.6	463.3	532.4	589.1	384.9
Days actually used during life	115	204	269	291	300	224
Average width of plow.....inches..	9.0	10.4	12.8	14.0	15.1	11.8
Cost when new	$8.00	$9.25	$11.50	$12.00	$13.00	$10.00
Total cost of repairs during life	17.25	24.64	25.27	27.28	27.95	23.99
Total interest during life at 6 per cent	3.25	3.66	4.45	4.84	3.78	3.86
Total of depreciation, interest, and repairs during life	28.50	37.55	41.22	44.12	44.73	37.85
Cost of walking plow:						
Per day used	$0.248	$0.184	$0.153	$0.151	$0.149	$0.169
Per acre plowed	.146	.107	.089	.082	.076	.098

The average cost of new walking plows of the average size shown in Table I is $10. Even though the heavier plows cost more money, the machinery and interest charges per acre and per day progressively decrease, as more work is done annually by the plow. There is a uniform decrease in the cost of repairs per acre as the acreage plowed annually is increased. The size and weight of the plow also increase with the increasing acreage. The average cost per acre for repairs is $0.062. The repairs made to a plow during its life amount to more than twice its first cost.

TABLE III.—*Sulky plows—relation of work done annually to service and cost per acre and per day used on 294 farms.*

Range of area covered annually.....acres..	1 to 20.	21 to 40.	41 and over.	Average.
Number of records included	89	150	55	.....
Average area covered annually.....acres..	14.3	32.8	55.1	30.9
Years of service rendered	11.3	7.0	6.2	8.1
Acres covered during life	161.6	229.6	341.6	250.3
Days actually used during life	83	108	150	119
Average width of plow.....inches..	11.0	13.1	16.5	13.3
Cost when new	$40.00	$45.00	$47.50	$42.50
Total cost of repairs during life	14.92	15.75	19.65	17.17
Total interest during life at 6 per cent	14.92	10.78	10.29	11.58
Total of depreciation, interest, and repairs during life	69.84	71.53	77.44	71.25
Cost of sulky plow:				
Per day used	$0.841	$0.662	$0.516	$0.590
Per acre plowed	.432	.311	.229	.284

THE SULKY PLOW.

The sulky plow (Table III) is much less generally used in western New York than is the walking plow, only 294 being reported as compared with 1,165 walking plows. Greater acreages are plowed daily per plow than with walking plows, and the number of days of work done annually by the sulky plow is somewhat less than for the walking plow. A sulky plow requires three horses for its proper operation, and this increased power applied to the implement results in greater

strain and wear on the working parts than for walking plows. The average sulky plow in this section works 119 days and plows 250 acres of land. Its cost new is over three times that of a walking plow; so that the overhead charges (replacement and interest) are five or six times as much per acre and over five times as much per day. The quality of work done by the sulky plow when properly operated is sufficiently superior to offset the greater overhead charges.

The decrease in cost per acre with increase of annual use show very conclusively the advantage of covering large acreages per plow annually.

The man with a small acreage may reduce his replacement cost somewhat by buying a lighter plow at a lower price, but even this does not eliminate the economic disadvantage under which he labors.

Sulky plows have a higher average repair charge per acre than do walking plows, the average being $0.069. The sulky plows in general use cost from $40 to $45, so that the total repair charges during life average 42 per cent of the first cost of the implement. The repair charges decrease as the acreage plowed is increased, this being in part accounted for by the larger plows used on the greater acreages.

THE SPRING-TOOTH HARROW.

In Table IV is shown the performance of spring-tooth harrows. The spring-tooth harrow is an implement that gives long service in years and also in terms of acres harrowed. Because of the large areas covered daily, its life in days actually worked averages only 73. The spring-tooth harrow is an implement that is given very poor shelter, its form making it awkward to house, and it often lies out unprotected from one year's end to another. The repair charges on these harrows are also very small. From the standpoint of work done it is a machine of very high efficiency, averaging 11 years of life and 782 acres of work. Table IV, like all of the other tables, shows that the larger machines which do the most work annually also do the greatest total of acres and days before being worn out.

TABLE IV.—*Spring-tooth harrows—relation of work done annually to service and cost per acre and per day used on 1,169 farms.*

Range of area covered annually.....acres..	1 to 40.	41 to 80.	81 to 150.	151 and over.	Average.
Number of records included	417	408	276	68	.....
Average area covered annually.....acres..	29.5	61.0	111.6	222.3	71.1
Years of service rendered	11.6	11.1	10.2	8.9	11.0
Acres covered during life	342.0	677.1	1,138.3	1,978.5	782.1
Days actually used during life	39	74	96	149	73
Average width of harrow.....feet..	5.7	6.5	8.2	10.4	6.9
Cost when new	$15.00	$17.00	$20.00	$24.00	$17.50
Total cost of repairs during life	6.15	8.88	9.28	10.86	8.25
Total interest during life at 6 per cent	5.92	6.22	6.73	8.16	5.83
Total of depreciation, interest, and repairs during life	27.07	32.10	36.01	43.02	31.58
Cost of spring-tooth harrow:					
Per day used	$0.794	$0.433	$0.375	$0.288	$0.432
Per acre harrowed	.079	.047	.032	.021	.043

The approximate cost of new spring-tooth harrows of the average sizes shown in Table IV is $17.50. The replacement cost for each time an acre is harrowed with the spring-tooth harrow is $0.023, and the interest charge per acre averages about $0.007.

The repair charges on spring-tooth harrows are very small per acre covered, being only $0.011 on the average. The total repairs made during the life of the average spring-tooth harrow cost about 47 per cent as much as the harrow itself when new.

THE SPIKE-TOOTH HARROW.

The spike-tooth harrow (Table V) is not in such general use in this section as is the spring-tooth harrow. It is a longer-lived implement than the spring-tooth harrow by about 27 per cent in terms of years, but it does about one-third less work in terms of acres. The class of soils on which the spike-tooth harrow can be used is lighter, and the character of work required of it is much less severe. In this section the spike-tooth harrow lasts an average of 14 years, doing 43 days of work and covering 676 acres of land. Like the spring-tooth harrow and walking plow, it is a low-priced implement, so that the interest charge, as well as the machinery or replacement charge per day and per acre, is relatively low.

Spike-tooth harrows of the average size given in Table V cost when new about $10.50. The average cost for harrowing an acre is $0.016 for replacement and $0.007 for interest.

TABLE V.—*Spike-tooth harrows—relation of work done annually to service and cost per acre and per day used on 824 farms.*

Range of area covered annually....acres..	1 to 20.	21 to 40.	41 to 60.	61 to 100.	101 and over.	Average.
Number of records included	193	301	151	138	41	.....
Average area covered annually.....acres..	15.7	33.3	52.8	86.4	166.6	48.3
Years of service rendered	18.4	13.6	12.9	12.4	10.0	14.0
Acres covered during life	288.9	452.9	681.1	1,071.4	1,666.0	676.2
Days actually used during life	24	37	40	64	79	43
Average width of harrow.....feet..	6.3	7.3	9.5	10.6	13.8	8.5
Cost when new	$7.75	$9.00	$12.00	$13.00	$17.00	$10.50
Total cost of repairs during life	2.76	4.22	3.35	7.32	7.70	4.76
Total interest during life at 6 per cent	4.42	3.94	5.29	5.21	5.60	4.76
Total of depreciation, interest, and repairs during life	14.93	17.16	20.64	25.53	30.30	20.02
Cost of spike-tooth harrow:						
Per day used	$0.622	$0.464	$0.516	$0.400	$0.383	$0.465
Per acre harrowed	.052	.038	.030	.024	.018	.029

The spike-tooth harrow is an implement having lower repair charges per acre than does the spring-tooth harrow, the average being only $0.007 per acre. It is not subjected to the severe strains met by the spring-tooth harrow, as the latter is used on much heavier and more stony land where the spike-tooth harrow would not work

at all. The total cost of repairs during the life of the spike-tooth harrow in this section amounts to only 20 per cent of the first cost of the implement.

THE DISK HARROW.

The disk harrows used in western New York (Table VI) show an average of 13 years, 457 acres, and 54 days of actual work. The 9-foot disk harrow, working 99 acres annually, as compared with a 5½-foot disk harrow, covering 16.7 acres annually, or one-sixth as much, lasts only two years less, covers five times as much land before wearing out, and works four times as many days. The cost of the larger implement exceeds that of the smaller by only 25 to 30 per cent. The farmer who has the greatest use for a disk harrow obtains the greatest return per day and per acre on his investment.

The depreciation charge against the disk harrow averages $0.059 per acre and the interest charge $0.025 per acre. The disk harrow is a much more expensive implement per acre than is the spike-tooth harrow or the spring-tooth harrow. Farmers who can use the larger disk harrows drawn by larger teams working over large acreages annually are seen to have a very great advantage economically in the matter of overhead charges.

TABLE VI.—*Disk harrows—relation of work done annually to service and cost per acre and per day used on 738 farms.*

Range of area covered annually ..... acres..	1 to 25.	26 to 50.	51 and over.	Average.
Number of records included	374	271	93	.....
Average area covered annually ..... acres..	16.7	38.8	99.0	35.2
Years of service rendered	13.8	12.4	11.7	13.0
Acres covered during life	230.5	481.1	1,158.3	457.6
Days actually used during life	30	55	121	54
Average width of harrow ..... feet..	5.5	6.8	9.0	6.4
Cost when new	$25.00	$28.00	$32.00	$27.00
Total cost of repairs during life	5.80	5.83	10.30	6.50
Total interest during life, at 6 per cent	11.18	11.28	12.17	11.31
Total of depreciation, interest, and repairs during life	41.98	45.11	54.47	44.81
Cost of disk harrow:				
Per day used	$1.40	$0.82	$0.45	$0.83
Per acre disked	.182	.094	.047	.098

Disk harrows are operated in this section at an average cost of $0.014 per acre for repairs. From Table VI it appears the total amount of repairs during the life of the average 6-foot disk harrow is $6.50, or about 24 per cent of the first cost of the machine.

THE LAND ROLLER.

The land roller is an implement which is subjected to a minimum of wear in use. From Table VII it is seen that a roller that covers 2,100 acres lasts nearly as long as one that covers less than 500 acres.

The roller is also damaged but little by exposure. It is one of the last implements to be housed, and often is not sheltered at all. From the standpoint of replacement, interest, and repair charges per acre, it is one of the most inexpensive implements on the farm. The average roller in western New York does 75 days of actual work, extending through a period of 16 years, covering 1,054 acres. The average replacement charge per acre is $0.023, and the interest charge at 6 per cent is $0.011.

TABLE VII.—*Land rollers—relation of work done annually to service and cost per acre and per day used on 1,173 farms.*

Range of area covered annually ..... acres..	1 to 40.	41 to 80.	81 and over.	Average.
Number of records included	425	493	255	.....
Average area covered annually ..... acres..	29.5	60.0	138.2	65.9
Years of service rendered	16.5	15.8	15.2	16.0
Acres covered during life	486.8	948.0	2,100.6	1,054.4
Days actually used during life	39	68	145	75
Average width of roller ..... feet..	7.2	8.0	10.0	8.1
Cost when new	$20.00	$22.00	$25.00	$24.00
Total cost of repairs during life	5.94	7.90	9.12	7.52
Total interest during life at 6 per cent	10.56	11.06	12.16	11.20
Total of depreciation, interest, and repairs during life	36.50	40.98	46.28	42.72
Cost of land roller:				
Per day used	$0.93	$0.60	$0.32	$0.57
Per acre rolled	.075	.043	.022	.041

Land rollers cost an average of only $0.007 per acre for repairs. The average land roller used in this area should cost about $24, and the total repairs necessary during its life average about 32 per cent of the original cost of the implement.

THE GRAIN DRILL.

The grain drill (Table VIII) is a comparatively expensive machine and is used only a few days in the year. The interest charge per day is therefore high. Grain drills in western New York last an average of 16.4 years in doing 76 days of work. Since they cover from 6 to 12 acres per day, the depreciation and interest charges per acre are but a small proportion of the cost of the men and horses used with them. Grain drills are substantially built, and are capable of doing many more days of work than the average farmer obtains from them.

From the computations for grain drills, it appears that there is an average depreciation charge of $0.095 per acre and an interest charge of $0.049 per acre. An $85 drill, doing 75 or more acres of work annually, costs less than one-third as much per acre as a $65 drill, doing less than 25 acres annually.

TABLE VIII.—*Grain drills—relation of work done annually to service and cost per acre and per day used on 1,061 farms.*

Range of area covered annually—acres	1 to 25.	25 to 50.	51 to 75.	76 and over.	Average.
Number of records included	272	505	195	89	.....
Average area covered annually—acres	20.2	40.5	65.1	117.5	46.3
Years of service rendered	15.5	16.6	15.7	13.9	16.4
Acres covered during life	353.5	672.3	1,022.1	1,633.3	759.3
Days actually used during life	39	67	102	160	76
Average width of drill—feet	5.1	6.3	6.4	7.3	6.2
Cost when new	$65.00	$72.00	$75.00	$85.00	$72.00
Total cost of repairs during life	13.83	20.75	27.63	24.88	20.66
Total interest during life at 6 per cent	36.05	39.01	37.68	38.09	37.56
Total of depreciation, interest, and repairs during life	114.88	131.76	140.31	147.97	130.22
Cost of grain drill:					
Per day used	$2.95	$1.94	$1.38	$0.92	$1.71
Per acre drilled	.328	.196	.137	.090	.171

Grain drills require an average repair expense of $0.027 per acre. The average 6-foot drill used in this territory costs about $72, and the total repairs made during its life amount to approximately 29 per cent of the cost when new.

THE CORN PLANTER.

Corn is usually planted in drills with the grain drill in western New York, so that few corn planters were reported for this section. The areas devoted to corn do not justify the purchase of a special planter for this work, as the cost of their use per day and per acre is greater than where the grain drill is employed to do the corn planting as well as the other seeding. From the limited data submitted for corn planters (Table IX), the 1-row type averages less than 1 day of use annually, while the 2-row type is used even less.

The replacement charges for corn planters costing $12 is $1.025 annually, or $0.25 per acre. The interest charge is $0.46 per annum, or $0.112 per acre. For planters costing $40 the corresponding charges are: Replacement, $3.64 per annum, or $0.438 per acre; interest, $1.13 per annum, or $0.136 per acre.

Corn planters are comparatively expensive tools to keep in repair. The average 1-horse planter costs $0.69 annually for repairs and the 2-horse planter $1.68 annually. The total repairs during the life of the 1-horse machine amount to an average of 67 per cent of its first cost, while the total for the 2-horse machine is about 46 per cent of the first cost. The average cost for repairs per acre in this section is $0.17 for the 1-horse planter and $0.20 for the 2-horse planter.

TABLE IX.—*Corn planters—relation of work done annually to service and cost per acre and per day used on 169 farms.*

Range of area covered annually ..... acres..	1 to 5.	6 to 10.
Number of records included	72	97
Average area covered annually ..... acres..	4.1	8.3
Years of service rendered	11.7	11.0
Acres covered during life	48.0	91.3
Days actually used during life	10	9
Size of implement	1-row.	2-row.
Cost when new	$12.00	$40.00
Total cost of repairs during life	8.07	18.48
Total interest during life at 6 per cent	5.38	12.41
Total of depreciation, interest, and repairs during life	25.45	70.89
Cost of corn planter:		
Per day used	$2.55	$7.89
Per acre planted	.53	.79

THE ONE-HORSE CULTIVATOR.

The average 1-horse cultivator lasts 14 years and does 58 days of work (Table X). The farmer who cultivates annually 60 acres, as compared with the man who cultivates only 7, obtains over five times as much acreage and days of use from a similar implement.

Although the larger acreages are cultivated by the more expensive and better implements the machines working the smaller acreages annually are, nevertheless, the more expensive per acre. The average depreciation charge was found to be $0.027 per acre and the interest charge, at 6 per cent, is $0.012 per acre.

TABLE X.—*One-horse cultivators—relation of work done annually to service and cost per acre and per day used on 926 farms.*

Range of area covered annually ..... acres..	1 to 10.	11 to 20.	21 to 40.	41 and over.	Average.
Number of records included	476	352	27	71	.....
Average area covered annually ..... acres..	6.8	15.4	28.2	57.9	16.9
Years of service rendered	15.2	14.7	12.8	9.6	14.0
Acres covered during life	103.4	226.4	361.0	555.8	236.6
Days actually used during life	25	56	89	137	58
Cost when new	$6.00	$6.50	$7.25	$8.50	$6.50
Total cost of repairs during life	3.80	5.88	5.37	5.47	4.90
Total interest during life at 6 per cent	2.89	3.09	3.07	2.69	2.94
Total of depreciation, interest, and repairs during life	12.69	15.47	15.69	16.66	14.34
Cost of 1-horse cultivator:					
Per day used	$0.507	$0.276	$0.176	$0.121	$0.247
Per acre cultivated	.123	.068	.043	.029	.060

The average repairs for 1-horse cultivators amount to $4.90 during their entire life, or about 75 per cent of the first cost of the implement. The average repair charge per acre is $0.021 and per day $0.085.

THE RIDING CULTIVATOR.

The riding cultivators used in this section (Table XI) last an average of 12.5 years, doing 491 acres or 70 days of work. A cultivator that covers 15 acres annually lasts only three years longer than one that cultivates 125 acres annually, being used in all less than one-sixth as many days. Rust and decay appear to exact a heavy toll of the man with limited use for his cultivator.

From the computations for riding cultivators it appears that the overhead charges per acre are more than twice those for the walking cultivator, the depreciation charge averaging $0.065 per acre and the interest charge $0.027. But to cover a given acre with a 1-horse cultivator requires nearly twice as many man hours as it does to cultivate the same area with a 2-horse implement. Where wages are low, especially if the area to be cultivated is small, the 1-horse implement is more economical; but where wages are high and the area large, it is cheaper to use a 2-horse implement.

TABLE XI.—*Riding cultivators—relation of work done annually to service and cost per acre and per day used on 881 farms.*

Range of area covered annually ..... acres..	1 to 20.	21 to 40.	41 to 80.	81 and over.	Average.
Number of records included	321	294	190	76	.....
Average area covered annually ..... acres..	14.7	31.6	58.3	124.8	39.3
Years of service rendered	13.7	12.8	11.4	10.7	12.5
Acres covered during life	201.4	404.5	664.6	1,335.4	491.3
Days actually used during life	28	57	93	186	70
Cost when new	$30.00	$32.00	$35.00	$36.00	$32.00
Total cost of repairs during life	8.91	12.67	13.34	21.72	12.38
Total interest during life at 6 per cent	13.29	13.31	13.00	12.63	13.00
Total of depreciation, interest, and repairs during life	52.20	57.98	61.34	70.35	57.38
Cost of riding cultivator:					
Per day used	$1.87	$1.02	$0.66	$0.38	$0.82
Per acre cultivated	.259	.143	.092	.057	.117

The average cost of repairs per acre for riding cultivators is $0.025, only a little more than for the walking type. The total repairs during the life of the average riding cultivator amount to about 40 per cent of its first cost.

THE CABBAGE TRANSPLANTER.

Cabbage transplanters, setting an average of 12.5 acres annually, last nearly 13 years, doing 43 days of actual work (Table XII). Farmers having the larger areas to plant obtain much greater acreages and days of work from their transplanters. These highly specialized planting machines could well be owned on shares, so that the implement cost per acre might be reduced by planting more acres annually.

TABLE XII.—*Cabbage transplanters—relation of work done annually to service and cost per acre and per day used on 217 farms.*

Range of area covered annually....acres..	1 to 10.	11 and over.	Average.
Number of records included	139	78	
Average area covered annually....acres..	6.2	28.8	12.5
Years of service rendered	13.2	11.9	12.8
Acres covered during life	81.8	283.2	160.0
Days actually used during life	22	77	43
Cost when new	$45.00	$45.00	$45.00
Total cost of repairs during life	11.74	18.56	14.46
Total interest during life at 6 per cent	19.14	17.37	18.56
Total of depreciation, interest, and repairs during life	75.88	80.93	78.02
Cost of cabbage transplanter:			
Per day used	$3.45	$1.05	$1.81
Per acre set	.927	.285	.487

For the use of a transplanter costing $45 there are charges for replacement and interest averaging $0.28 per acre for depreciation and $0.114 per acre for interest at 6 per cent.

The repairs on cabbage transplanters average $0.091 per acre or $0.336 per day used. The average transplanter costs about $45 and the repairs necessary during its life amount to about 36 per cent of the original outlay for the machine.

ENGINE SPRAYER.

The average cost of repairs for gasoline-engine-operated spraying outfits is $0.27 per day (Table XIII). The number of trees per acre is so variable that it is most convenient to consider repair charges on the basis of the tree rather than the acre.

TABLE XIII.—*Cost of repairs for gasoline-engine-driven power sprayers in western New York.*

Days used annually.		Cost of repairs.		Number reporting.
Range.	Average.	Per sprayer annually.	Per day used.	
1 to 5	3.9	$1.05	$0.27	41
6 to 10	9.0	3.35	.37	140
11 to 15	13.6	5.06	.37	71
16 to 20	19.2	5.44	.28	52
21 and over	37.6	5.85	.16	55
Average	15.2	4.11	.27	359

The average number of trees that can be sprayed in a day with a gasoline-engine outfit is about 220, the trees having an average height and spread of 18 to 20 feet. The average repair cost per tree amounts

to about one-eighth of 1 cent. The average cost per tree for trees of different height [1] is approximately as follows:

Height of tree.	Cost per tree.
12 feet or less	$0.0008
13 to 20 feet	.0015
21 feet and over	.0021
Average	.0012

The cost per acre depends upon the number of trees planted per acre, and can readily be computed for any given orchard by multiplying the appropriate one of the above amounts by the number of trees per acre.

MOWERS.

While the mower is a machine with rapidly reciprocating parts, it gives relatively long service. Inspection of Table XIV indicates that the average farmer does not obtain the maximum days of work from his mower. Mowers that cut 14 acres annually last only four years longer than machines that cut 90 acres a year, the latter doing 100 days of work against 25 for the former. The size of the mower has some influence on the total acres cut by mowers before wearing out, but the principal contributing factor to a high record of days of work appears to be large acreage annually.

TABLE XIV.—*Mowers—relation of work done annually to service and cost per acre and per day used on 1,232 farms.*

Range of area covered annually.....acres..	1 to 15.	16 to 30.	31 to 45.	46 to 60.	61 and over.	Average.
Number of records included	368	518	193	110	43	
Average area covered annually.....acres..	13.8	23.6	38.8	53.6	88.8	28.0
Years of service rendered	16.1	14.3	14.6	13.1	11.9	14.8
Acres covered during life	222.2	337.5	566.5	702.2	1,056.7	414.4
Days actually used during life	25	38	60	70	100	46
Average width of mower.....feet..	4.9	5 0	5.4	6.0	6.4	5.2
Cost when new	$40.00	$40.00	$42.00	$45.00	$47.50	$41.00
Total cost of repairs during life	19.00	24.45	35.77	37.47	37.84	26.94
Total interest during life, at 6 per cent	20.45	18.30	19.71	19.00	18.33	19.39
Total of depreciation, interest, and repairs during life	79.45	82.75	97.48	101.47	103.67	87.33
Cost of mower:						
Per day used	$3.18	$2.18	$1.62	$1.45	$1.04	$1.90
Per acre mowed	.357	.245	.172	.144	.098	.210

The overhead charges against mowers doing the amount of annual work shown in Table XIV average $0.099 for depreciation and $0.047 for interest per acre.

[1] Computed from Table XXVI, U. S. Dept. of Agr. Bul. No. 3.

The mower requires repairs amounting to $0.065 per acre, or $0.60 per day used. The total repairs necessary during the life of the average mower amount to $26.94, or about 66 per cent of the cost of a new mower at $41.

THE HAY RAKE.

From the standpoint of shelter when not in use, the hay rake (Table XV) is probably the most abused implement on the farm. It is a tool which covers large acreages in a day, so that its low record of actual days of work is offset by a low overhead cost per acre and per ton. The average 10-foot rake in this section lasts 14.5 years in doing 37 days of work, and raking 623 acres of hay.

Against hay rakes in western New York costing an average of $24, the average depreciation charge per acre is $0.038 and the interest charge $0.019. These overhead charges become steadily less as the acreage raked annually is increased.

TABLE XV.—*Hay rakes—relation of work done annually to service and cost per acre and per day used on 1,217 farms.*

Range of area covered annually ....acres..	1 to 25.	26 to 50.	51 and over.	Average.
Number of records included	402	525	290	.....
Average area covered annually ....acres..	17.8	39.1	84.9	43.0
Years of service rendered	13.0	15.6	13.8	14.5
Acres covered during life	231.4	610.0	1,171.6	623.5
Days actually used during life	16	36	67	37
Average width of rake ....feet..	8.6	9.9	11.4	9.8
Cost when new	$22.00	$24.00	$26.00	$24.00
Total cost of repairs during life	3.64	5.93	6.07	5.22
Total interest during life, at 6 per cent	9.23	12.01	11.49	11.17
Total of depreciation, interest, and repairs during life	34.87	41.94	43.56	40.39
Cost of hay rake:				
Per day used	$2.19	$1.17	$0.65	$1.09
Per acre raked	.151	.069	.037	.065

The hay rake is used without heavy repair charges, the average being only $0.008 per acre, or $0.141 per day used. The total repairs during its life are only $5.22, or about 22 per cent of its original cost.

THE HAY TEDDER.

The hay tedder is an implement that must be kept on hand by growers of considerable acreages of hay, but in some seasons it is not used much. Of the 416 tedders reported in Table XVI, the average service is 14 years, out of which only 21 days' use of the tedder is obtained.

The overhead charges per acre on hay tedders average $0.112 for depreciation and $0.051 for interest.

TABLE XVI.—*Hay tedders—relation of work done annually to service and cost per acre and per day used on 416 farms.*

Range of area covered annually ....acres..	1 to 15.	16 to 30.	31 and over.	Average.
Number of records included	174	190	52	
Average area covered annually....acres..	9.9	23.9	52.2	21.6
Years of service rendered	14.8	13.8	12.6	14.0
Acres covered during life	146.5	329.8	657.7	302.4
Days actually used during life	10	23	46	21
Cost when new	$32.00	$35.00	$35.00	$34.00
Total cost of repairs during life	3.85	7.04	6.68	5.74
Total interest during life, at 6 per cent	15.10	15.69	14.24	15.26
Total of depreciation, interest, and repairs during life	50.95	57.73	55.92	55.00
Cost of hay tedder:				
Per day used	$5.10	$2.51	$1.21	$2.61
Per acre tedded	.348	.175	.085	.181

The annual repairs for a hay tedder average only $0.41, the cost per acre being $0.019. The hay tedder is used only a few days in the season. The repair cost per day amounts to $0.273. The average first cost of a hay tedder is about $34, so that the total repairs needed during its life on the farm are only 17 per cent of the original cost of the implement.

THE BEAN HARVESTER.

The bean harvester used in western New York is an implement with no moving parts, and lasts about 13 years, of which 29 days are spent in actual work harvesting 218 acres. If wheel bearings are properly lubricated and the knives kept repaired or replaced as they wear, these machines should last almost indefinitely. The data of Table XVII indicates that the amount of work done up to 45 days has little effect on the life of the harvesters.

TABLE XVII.—*Bean harvesters—relation of work done annually to service and cost per acre and per day used on 563 farms.*

Range of area covered annually ....acres..	1 to 10.	11 to 20.	21 to 30.	Average.
Number of records included	168	266	129	
Average areas covered annually....acres..	8.5	17.1	27.6	16.9
Years of service rendered	13.7	12.5	12.7	12.9
Acres covered during life	116.4	213.8	350.5	218.0
Days actually used during life	15	28	46	29
Cost when new	$25.00	$25.00	$25.00	$25.00
Total cost of repairs during life	8.63	12.50	19.81	13.03
Total interest during life, at 6 per cent	11.10	10.13	10.16	10.32
Total depreciation, interest, and repairs during life	44.73	48.03	54.97	48.35
Cost of bean harvester:				
Per day used	$2.98	$1.71	$1.19	$1.67
Per acre harvested	.384	.224	.156	.221

On bean harvesters the average depreciation charge per acre is $0.115 and the interest charge $0.048.

The cost of repairs for the bean harvester averages $0.06 per acre, $0.449 per day used, and $13.03 for its entire life on the farm, or about 60 per cent of its first cost.

THE GRAIN BINDER.

Although a grain binder is a large and complicated machine, with many revolving and reciprocating parts, it lasts an average of over 15 years in western New York in cutting 542 acres, but does only 53 days of actual work (Table XVIII). As in the case of other implements, the smaller binders last longer in years but do less work in days and acres than the larger machines.

TABLE XVIII.—*Grain binders—relation of work done annually to service and cost per acre and per day used on 1,028 farms.*

Range of area covered annually ..... acres..	1 to 20.	21 to 40.	41 to 60.	61 and over.	Average.
Number of records included	274	494	191	69	.....
Average areas covered annually ..... acres..	15.5	32.5	52.8	85.0	35.2
Years of service rendered	17.8	14.4	14.2	13.6	15.4
Acres covered during life	275.9	468.0	749.8	1,156.0	542.1
Days actually used during life	27	45	92	103	53
Average width of binder ..... feet..	5.6	6.0	6.1	7.1	6.0
Cost when new	$125.00	$125.00	$130.00	$135.00	$125.00
Total cost of repairs during life	24.92	26.50	39.05	54.67	31.20
Total interest during life at 6 per cent	70.49	57.74	59.21	59.16	61.60
Total of depreciation, interest, and repairs during life	220.41	209.24	228.26	248.83	218.02
Cost of grain binder:					
Per day used	$8.15	$4.47	$3.17	$2.42	$4.11
Per acre cut	.80	.447	.304	.215	.402

For grain binders the depreciation and interest charges average $0.231 and $0.113 per acre, respectively. A binder that cuts 16 acres annually costs about 3½ times as much per acre as one that cuts 70 acres a year. As the acreage cut increases the interest charge becomes a smaller proportion of the total overhead charge, as is the case with the other implements.

It costs nearly 60 cents a day of use to keep a grain binder in repair, or $0.058 per acre cut. Before a binder is worn out 25 per cent of its first cost, on the average, must be spent to keep it in running order.

THE CORN BINDER.

From Table XIX it appears that the corn binder is not in such common use as are the grain binder, mower, and other standard machines in this section. The average corn binder does only 40 days of actual work, and there is no doubt but that it could render several times this much service before wearing out.

TABLE XIX.—*Corn binders—relation of work done annually to service and cost per acre and per day used on 458 farms.*

Range of area covered annually ....acres..	1 to 15.	16 and over.	Average.
Number of records included	233	225	.....
Average area covered annually....acres..	10.1	32.5	21.2
Years of service rendered	11.0	10.6	10.8
Acres covered during life	111.1	344.5	227.9
Days actually used during life	19	60	40
Cost when new	$125.00	$125.00	$125.00
Total cost of repairs during life	15.73	28.20	21.92
Total interest during life at 6 per cent	45.00	42.46	43·28
Total of depreciation, interest, and repairs during life	185.73	195.66	190.20
Cost of corn binder:			
Per day used	$9.78	$3.24	$4.76
Per acre cut	1.67	.568	.83

The replacement cost averages $0.55 per acre and the interest charge at 6 per cent is $0.194 per care.

The corn binder requires an expenditure of $0.096 per acre for repairs, or about $0.50 for each day used. About 17½ per cent must be added to its original cost for repairs during its life.

RELATION OF ANNUAL REPAIRS TO FIRST COST.

In making farm plans for the years to come, it is often desirable to know what the normal relation is between the first cost of an implement and the annual repairs which must be provided for. Table XX has been prepared for the purpose of affording data of this character for the implements discussed in this bulletin. The sizes of implements shown in the first column of the table are the same as the averages for the corresponding implements in Tables II to XIX.

The first cost in the second column is taken from farm inventories recorded in the western New York area. The third column of the table shows the percentage of the first cost that must, on the average, be laid out annually for repairs for each implement.

The fourth column is the average present value of the respective implements that would be obtained by making an inventory valuation and computing the average.[1] The fifth column shows the percentage of the present value that must be laid out for repairs annually to keep each machine in running order.

[1] The fourth column of the table represents the average investment upon which the farmer must earn interest at the borrowing rate in his locality where he charges off for depreciation annually a part of the first cost in proportion to the average life of his respective implements. This average investment is identical with the average present value that would be obtained by making an inventory valuation of the same implements and computing the average. The relation of first cost to average farm value of machinery in use is shown on page 5 for equipment having average life ranging from 1 to 20 years.

TABLE XX.—*Relation of the annual outlay for repairs to the first cost and present value of farm implements in western New York.*

Implement.	Average size.	First cost.	Per cent of first cost expended annually for repairs.	Average present value.	Per cent of present value expended annually for repairs.
Walking plow	11.8 inches.	$10.00	20.5	$5.43	37.8
Sulky plow	13.3 inches.	42.50	5.0	23.88	8.9
Spring-tooth harrow	6.9 feet	17.50	4.3	9.54	7.9
Spike-tooth harrow	11 feet	17.00	2.0	9.01	3.8
Disk harrow	6.4 feet	27.00	1.8	14.54	3.4
Land roller	8.1 feet	24.00	2.0	12.75	3.8
Grain drill	6.2 feet	72.00	1.8	38.19	3.3
Corn planter	1-row	12.00	5.8	6.51	10.6
Do	2-row	40.00	4.2	21.82	7.7
1-horse cultivator		6.50	5.4	3.48	10.0
Riding cultivator		32.00	3.1	17.28	5.7
Cabbage setter		45.00	2.5	24.26	4.7
Mower	5.2 feet	41.00	4.4	21.89	8.3
Hay rake	9.8 feet	24.00	1.5	12.83	2.8
Hay tedder		34.00	1.2	18.31	2.2
Bean harvester		25.00	4.0	13.47	7.5
Grain binder	6 feet	125.00	1.6	66.56	3.1
Corn binder		125.00	1.6	69.54	2.9

From Table XX it appears that the walking plow is the only implement that requires much over 5 per cent of its first cost to be expended annually for repairs; corn planters are so little used here that the data for these implements, showing 5 per cent annually, may be only approximately correct.

Tabulation of the repair expense according to the age of the implements showed no uniform increase in repair cost as the age increased, the repairs being low the first year or two and practically the same per year thereafter.

SHELTER.

Much has been written and said about the waste incurred by lack of housing for machinery on farms. Many large and successful farmers do not shelter their machinery at all. The principle which guides them is that if a machine not housed at all will wear out before it is injured by exposure there is no need to shelter it. The larger the amount of work that can be done with an implement annually, therefore, the less need there is to house it. The waste, by depreciation, of capital invested in farm machinery is caused primarily by the inability of the smaller farms to wear out their implements with profitable use. An economic remedy is partial reorganization of their business and cooperation with neighbors so that more work can be done annually with the machinery equipment.

There are no data available on the relative life of machinery when housed and when not housed. Careful study of the cost of housing farm machinery in an area in eastern New York indicated that farmers do not invest in special machinery shelter to a greater extent than 20 per cent of the first cost of their implements. Similar data from eastern Nebraska gave a percentage of 10 or less, the relative

amount decreasing as the size of farm increased. The greater humidity in New York makes more urgent the shelter of implements while the larger areas farmed in Nebraska makes such shelter less economical. The more substantial methods of construction in New York also add to the greater relative cost. As previously noted, except during a period in summer when the general buildings are filled with crops, there is usually ample space available for housing most of the farm machinery on farms in western New York. It would seem that an investment in special implement sheds amounting to over 15 per cent of the total cost of farm machinery would indicate poor management in utilizing available space in the general farm buildings for the purpose of housing such machinery.

The walking plow, disk harrow, land roller, 1-row cultivator, hayrake, and hay tedder are among the more expensive implements to house in proportion to their cost. They constitute the group most frequently not housed. It happens that, being made of heavy wooden or metal parts with few moving elements, they are less injured by exposure than are some others. They can endure considerable exposure when barns are filled with crops, and are more economically stored at other times in general-purpose space. Machines such as binders, mowers, drills, planters, etc., having many moving parts, or many of light metal or wood, are seriously affected in operation by rust and decay and are in greater need of protection from the weather, hence they are the first to be housed in this and other sections. Their form renders them economical to house from the standpoint of relative cost of machine and shelter. It is ordinarily profitable to provide special shelter for these machines. There is no way, however, by which the small farmer can escape a greater shelter charge per acre than that enjoyed by the large farmer.

RELATION OF MACHINERY COST TO COST OF FARM OPERATIONS.

The most urgent reason for investment in machine sheds, farm repair shops, and repair tools is that machinery will then be more readily and certainly repaired and kept in running order, so that it will not fail during busy seasons and waste the more expensive time of men and horses.

In Table XXI the relation of the cost of machinery to the total cost of the various farm operations with these implements has been computed and expressed in percentages. In arriving at these percentages, the general averages were taken from Tables II to XIX, respectively, as being the average cost to the farmers in western New York. Man time was taken at $2 per day for wages and board, with all implements except those used in haying and in grain harvest, the wages for these being placed at $3.25 per day for wages and board. Horse time was entered at 75 cents per day per horse to cover feed, interest, depreciation, and mortality.

TABLE XXI.—*Relation of machinery cost to the total cost of farm operations in western New York.*

Operation.	Men.	Horses.	Per cent of cost contributed by the implements.	Operation.	Men.	Horses.	Per cent of cost contributed by the implements.
Plowing (walking)	1	2	4.7	Cultivating	1	1	8.2
Plowing (sulky)	1	3	12.6	Do	1	2	19.1
Harrowing (spring tooth)	1	2	11.2	Transplanting cabbage	3	2	19.4
Harrowing (spike tooth)	1	2	11.7	Mowing hay	1	2	28.7
Harrowing (disk)	1	2	19.2	Raking hay	1	2	18.7
Rolling	1	2	14.0	Tedding hay	1	2	35.6
Drilling grain	1	2	32.8	Harvesting beans	1	2	32.3
Planting corn	1	1	48.0	Harvesting grain (binder)	1	2	42.8
Do	1	2	69.9	Harvesting corn (binder)	1	3	52.7

With the exception of corn planters and corn binders, which are used only a day or two annually, the machinery cost of the various operations does not exceed 50 per cent of the whole, while for the standard farm operations the machinery cost ranges from 4.7 per cent for the walking plow to 42.8 per cent for the grain binder. These percentages represent the average of conditions in western New York. The larger farms enjoy a much lower percentage of machinery cost and those smaller than the average labor under much heavier charges. Where larger numbers of horses are used the machinery cost is, of course, relatively less.

It appears to be more economical to keep the machinery cost of farm operations down by management that will secure a maximum number of days of profitable service from each implement annually than to spend money to shelter idle machinery. It is still more important to keep men and horses profitably engaged the maximum number of days in the year, since these are much more expensive than the machinery, both in daily cost while working and, in the case of horses, in depreciation, interest, and maintenance charges while not working.

CONCLUSION.

The averages of the foregoing tables represent the normal repair cost for the respective implements doing the annual amounts of work indicated. The data thus made available are of permanent utility in arriving at the cost of farm enterprises where these machines are used.

The replacement and interest charges computed for the respective implements in this bulletin will serve as a basis for computing the proper overhead charges for machinery at other prices and interest rates and doing the same amount of annual work, by the simple operation of applying proportion to the averages given here. For the conditions in western New York the overhead charges as computed are basic in character, and will be of service in determining the cost of work done or to be done on the farm, in deciding whether to buy or rent farm machinery, and in solving countless other problems in farm management and organization.

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